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AUTHOR Kelner, Bernard G.; Hofkin, Fred M.
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ABSTRACT

Presented is a list of behavioral objectives which can be used to evaluate mastery of the competency of students in elementary school science. These competencies were prepared by the School District of Philadelphia. The lists are comprehensive and coded for easy reference. (CS)

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KEY COMPETENCIES

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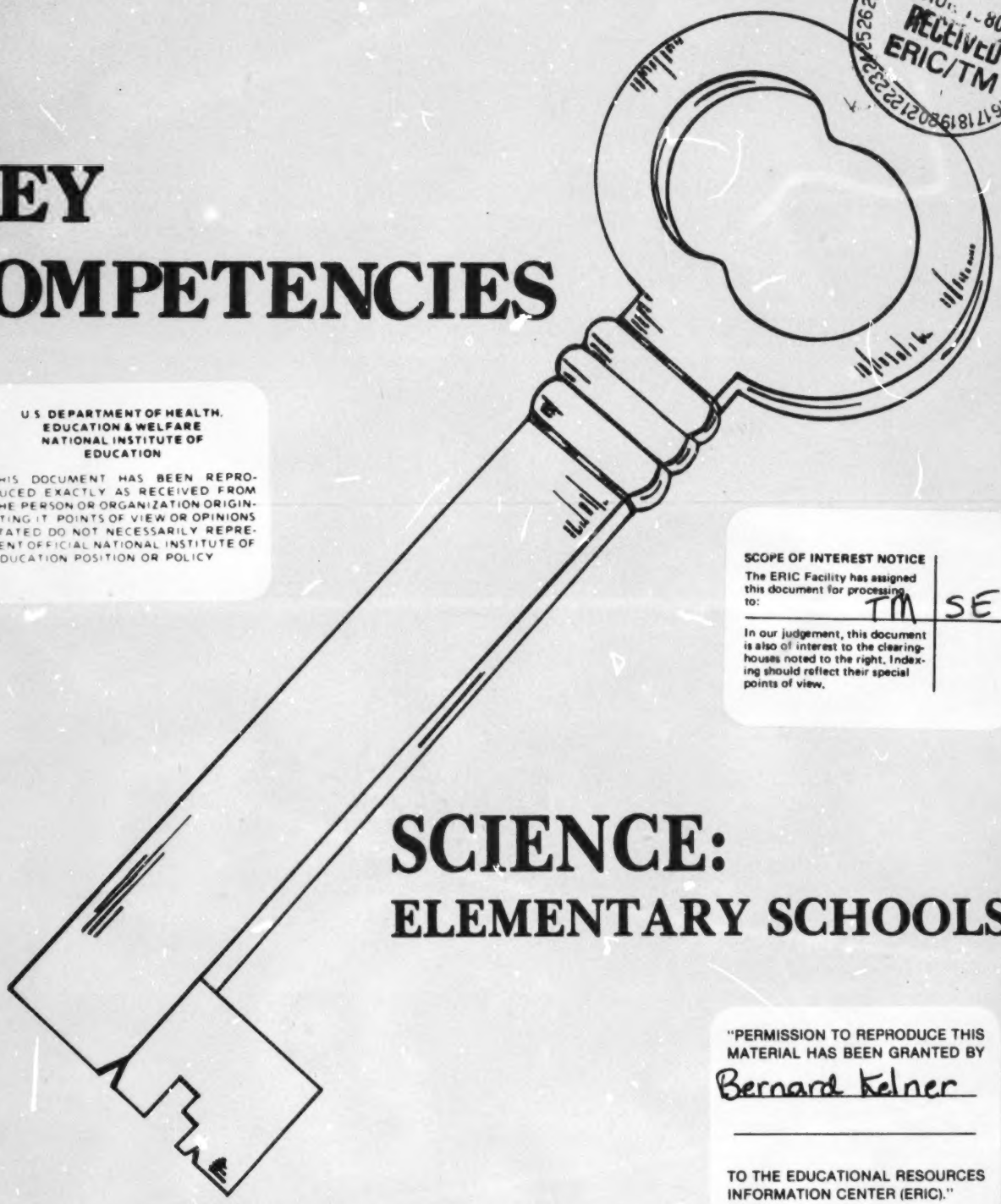

SCIENCE:
ELEMENTARY SCHOOLS

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Division of Science Education

Key Competencies

SCIENCE EDUCATION
(Elementary)
(E-Sci)

Bernard G. Kelner
Associate Superintendent
Curriculum and Instruction

Fred M. Hofkin
Director
Science Education

1980

AUG 4 1980

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Associate Superintendent
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Phone: 299-7767

File #200

June 2, 1980

Dear Colleagues:

The School District of Philadelphia is committed to quality education for all its students. In this regard, two recent events are of particular significance: the Board of Education resolution reaffirming the use of mandated curricula and the Superintendent's "Blueprint for Academic Achievement." All schools, unless receiving official approval to do otherwise, are to use the School District's courses of study; all students are to be considered as having high potential.

The "Blueprint" calls for the identification of essential learning for each grade. To assist principals and teachers, the Office of Curriculum and Instruction has prepared "Key Competencies" for the mandated subjects. With each competency are behavioral objectives which can be used to evaluate mastery of the competency. The lists are comprehensive and coded for easy reference. Each publication contains the sequence of competencies for either elementary or secondary subjects thus providing a perspective of learning over a period of time. Copies are being distributed to all personnel directly involved with instruction.

It should be noted that the term *key competency* signifies the opening of the door to learning. In no way should mastery of these competencies be considered the limit of education. The courses of study provide a full array of content and activities. On the other hand, failure to master the key competencies should be a signal for intensive evaluation of the effectiveness of the educational program - a process calling for collaborative effort of school, home, and if need be, community.

A curriculum publication is, by its very nature, always in a state of development. Your review of this document is eagerly sought and your recommendations will be deeply appreciated. Please send your comments to me. I am as close to you as your phone.

With every good wish.

BERNARD G. KELNER
Associate Superintendent
Curriculum and Instruction

BGK/ar

SCIENCE EDUCATION

The major goal of science education is to develop scientifically literate and concerned individuals with a high competence for rational thought and action. This goal is based on the belief that achieving scientific literacy involves the development of attitudes, process skills, and concepts necessary to meet the more general goals of all education, such as:

a. learning how to attack new problems, how to acquire new knowledge.
b. using rational processes.
c. building competence in basic skills.
d. developing intellectual and vocational competence.
e. exploring values in new experiences.
f. understanding concepts and generalizations.
g. learning to live harmoniously within the biosphere.

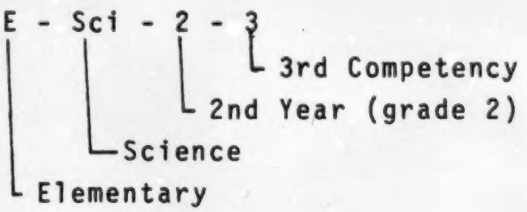
Above all, science education develops in the individual an ability to learn under one's own initiative.

The scope of the science program is for grades kindergarten through twelve.

The booklet will treat the key competencies in the elementary program (grades kindergarten through six).

The following coding system was used to designate the competencies:

Example:



01 - Student Outcome 1
02 - Student Outcome 2
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Note: The following courses are given in the elementary program:

E - Sci - K - Kindergarten
E - Sci - 1 - 1st Year (Grade 1)
E - Sci - 2 - 2nd Year (Grade 2)
E - Sci - 3 - 3rd Year (Grade 3)
E - Sci - 4 - 4th Year (Grade 4)
E - Sci - 5 - 5th Year (Grade 5)
E - Sci - 6 - 6th Year (Grade 6)

For further information regarding science education, its curriculum and services, please refer to Curriculum Means Service or contact:

Dr. Fred M. Hofkin, Director
Division of Science Education
Administration Building
Parkway at 21st St. - Rm. 305
Philadelphia, PA 19103

Phone: 299-7771

ELEMENTARY SCIENCE
(E-Sci-K)

Key Competencies

KINDERGARTEN

E-Sci-K-1 STUDENTS WILL DEMONSTRATE OBSERVATION SKILLS:

01. Identify, name, and sort objects according to primary and secondary colors.

02. Identify and name common two dimensional shapes (square, triangle, rectangle, circle).

03. Classify according to various single characteristics (color, size, texture, solid, liquid, gas, etc.)

04. Observe and describe experiences using senses of taste, smell, hearing, touch and sight.

05. Classify objects according to their use.

06. Identify sets that have fewest members, the most members, and equivalent members.

07. Name and demonstrate movements of up, down, forward, backward, right, and left.

08. Distinguish between moving and non-moving objects.

09. Order objects according to length and weight.

10. Observe with a magnifying glass that objects have smaller parts.

11. Describe the properties of floating or non-floating objects in water.

12. Observe and describe the process of melting.

E-Sci-K-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF GROWING THINGS:

01. Investigate the properties of seeds (size, color, shape, etc.)

KINDERGARTEN

E- Sci-K-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF GROWING THINGS (continued):

02. Classify objects as living or non-living.

03. Describe some of the characteristics of animals (breathing, eating, eliminating waste, need for water, reproduction, etc.)

04. Identify some of the seasonal changes that occur in animals and plants (hibernation, migration, hair growth, color change, falling leaves, etc.)

05. Name senses used in making observations.

06. Identify living things on a neighborhood walk.

07. Observe and care for the animals in an aquarium.

ELEMENTARY SCIENCE
(E-Sci-1)

Key Competencies

GRADE 1

E-Sci-1-1 STUDENTS WILL DEMONSTRATE SKILLS IN CLASSIFICATION:

01. Describe objects according to the following properties.
    a. shape
    b. color
    c. size
    d. texture
    e. taste
    f. odor

02. Classify objects into groups according to the properties of color, size, shape, texture, and function.

03. Identify six special shapes:circle, triangle, square, rectangle, diamond, and ellipse.

04. Identify shapes that are open, closed, straight, rounded, or have corners.

05. Observe and identify likeness and differences in the properties of grouped objects.

06. Identify common sounds.

07. Identify changes in the form of an object.

E-Sci-1-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE RELATED TO LIVING ORGANISMS:

01. Identify objects as living or non-living.

02. Identify living and non-living objects according to color, size, shape, and texture.

03. Distinguish between plants and animals as similar to, or different from each other.

GRADE 1

E-Sci-1-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE RELATED TO LIVING ORGANISMS (continued):

04. Identify habitats in which plants and animals live.

05. Identify growth changes in plants and animals.

06. State that living things are capable of reproducing in like kind.

07. Describe weather in terms of rain, snow, wind, temperature, and sky conditions.

08. Identify and describe unwanted environmental changes.

E-Sci-1-3 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS REGARDING PROPERTIES AND ATTRIBUTES:

01. Name two or more senses that can be used to identify properties in the same object.

02. Arrange collections of similar objects in serial order according to property.

03. Measure properties of objects using standard units of measurement.

04. Describe the effects of hot and cold on a thermometer.

05. Demonstrate movements such as up, down, forward, backward, right, and left.

06. Compare and describe the relative weight of a given object.

07. Identify bilateral symmetry.

ELEMENTARY SCIENCE
(E-Sci-2)

Key Competencies

GRADE 2

E Sci-2-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO PROPERTIES OF OBJECTS:

01. Identify and describe the materials from which objects are made.

02. Distinguish between solid, liquids, gases, according to their properties.

03. Identify solids as objects that keep their shape, and can be picked up and stacked.

04. Identify some properties of solids.

05. Describe properties of solids with respect to their use.

06. Identify some properties of liquids.

07. Compare specific properties of liquids.

08. Infer the presence of gases.

09. Describe the properties of several different gases.

10. Describe changes in the properties of objects that occur during an experiment.

11. Identify changes in shape, size, color, texture, and weight of objects that occur during an experiment.

12. Identify interacting objects.

13. Record the names of objects essential to a given interaction.

14. Demonstrate that a reaction is the result of an action.

15. Distinguish properties of symmetry and asymmetry of two-dimensional objects.

GRADE 2

E-Sci-2-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO PROPERTIES OF OBJECTS (continued):

16. Identify two-dimensional objects as components of three-dimensional objects.

E-Sci-2-2 STUDENTS WILL DEMONSTRATE A KNOWLEDGE AND SKILLS REGARDING LIFE CYCLES:

01. Classify objects into living and non-living things.

02. Describe the similarities and differences among a variety of living things.

03. Describe and distinguish being born, growing, reproducing, feeding, moving, resting, and dying as characteristics of all living things.

04. Observe changes as a plant grows from a seed or a cutting.

05. Record changes in a plant as it grows from a seed or a cutting.

06. Identify the place where a plant or animal naturally lives as a habitat.

07. Construct a habitat.

E-Sci-2-3 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILL REGARDING OBSERVATION AND MEASUREMENT:

01. Describe length, width, and height of an object to the nearest centimeter.

02. Construct a simple graph.

03. Construct a classification system based on a set of observations.

04. Distinguish between an observation and an inference.

05. Record data of observations and inferences.

ELEMENTARY SCIENCE
(E-Sci-3)

Key Competencies

GRADE 3

E-Sci-3-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE OF SYSTEMS AND VARIABLES:

01. Describe a sequence of interaction in a system.

02. Identify a system.

03. Name systems in terms of interactions of their parts.

04. Identify a variable in a system.

05. Identify a sub-system within a system.

06. Identify sub-systems which may be separated from a liquid mixture by filtration or evaporation.

07. Observe the following phenomena:
    a. melting of solids
    b. freezing
    c. boiling and evaporation of liquid
    d. condensation of gases

08. Describe the following phenomena:
    a. melting of solids
    b. freezing
    c. boiling and evaporation of liquids
    d. condensation of gases.

09. Classify liquid mixtures as solutions and non-solutions.

10. Construct an electrical circuit.

11. Demonstrate an open and closed circuit.

12. Identify the following three-dimensional objects:
    a. sphere
    b. cube
    c. cylinder
    d. cone
    e. pyramid

GRADE 3

E-Sci-3-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS REGARDING LIVING POPULATIONS:

01. Name and list properties which may be used to distinguish plants from animals.

02. Identify changes in a living object over a period of time.

03. Identify changes in the habitat of a population.

04. Record changes in the habitat of a population.

05. Match organisms with their habitats.

06. Identify factors which may affect population growth.

07. Predict the increase or decrease in the size of a population based upon reproductions and deaths of organisms.

08. Describe ways in which animals adapt to their environment.

09. Identify predators and prey.

10. Describe a food chain.

11. Connect food chains to a food web.

E-Sci-3-3 STUDENTS WILL DEMONSTRATE SKILLS IN SCIENCE PROCESSES:

01. Distinguish between an observation and an inference concerning objects or events.

02. Describe the expected outcome of a set of inferences.

03. Construct predictions based on data.

04. Construct a revision of a prediction based on additional data.

05. Identify simple techniques for testing phenomena.

06. Construct (collectively) a histogram for comparing data.

GRADE 3

E-Sci-3-3 STUDENTS WILL DEMONSTRATE SKILLS IN SCIENCE PROCESSES (continued):

07. Measure the properties of objects using simple devices.

08. Distinguish between relative weights of objects.

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ELEMENTARY SCIENCES
(E-Sci-4)

Key Competencies

GRADE 4

E-Sci-4-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS OF RELATIVE POSITION AND MOTION:

01. Name reference objects in the immediate environment to describe relative position of other objects.

02. Identify basic directions (above and below, right and left, front and back) when describing relative position.

03. Identify and describe motion, or lack of motion, relative to a selected object.

04. Identify and demonstrate change of relative position as evidence of relative motion.

05. Identify variables that affect the "tracks" of moving objects.

06. Identify objects and places using polar coordinates.

07. Indicate directions using degrees.

08. Demonstrate how objects and places can be located by using rectangular and polar coordinates.

09. Identify objects by position rather than by property.

10. Identify relative positions by using puzzles.

11. Demonstrate how distance and direction cards can be used to describe position of objects.

E-Sci-4-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ENVIRONMENTS:

01. Identify environmental factors that affect organisms.

02. Describe the seasonal changes in organisms and their environments.

GRADE 4

E-Sci-4-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ENVIRONMENTS (continued):

03. Construct an experiment to determine animal responses to selected environmental factors.

04. Construct an experiment to determine plant responses to a variety of environmental conditions.

05. Identify and describe the environment of isopods and snails.

06. Construct a means of communicating recorded observations of increase or decrease in populations of isopods, snails, beetles, grass, clover, and beans in terraria.

07. Describe and locate the environments of organisms outside the classroom but within the immediate environment.

08. Distinguish the recorded responses of isopods to different intensities of light and quantities of water.

09. Identify and describe the concepts "range" and "optimum range".

10. Construct class charts which communicate the measured growth of seedlings and their average growth rates.

11. Control variables by growing plants under differing environmental conditions such as light, temperature, and water.

12. Construct an experiment to determine the optimum range of water for bean germination.

13. Construct and demonstrate data of plant responses to chemical fertilizers.

14. Describe similarities and differences in the responses of plants and animals to changes in environmental factors.

GRADE 4

E-Sci-4-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ENVIRONMENTS (continued):

15. Identify and demonstrate how experimental data is used to plan and construct a terrarium.

16. Construct a terrarium providing optimum ranges of some environmental factors.

E-Sci-4-3 STUDENTS WILL DEMONSTRATE SKILLS IN USING DATA:

01. Construct a bar graph from a frequency distribution.

02. Distinguish observations which are relevant to the solution of a problem from those which are not.

03. Demonstrate linear measurement in meters, centimeters, and millimeters.

04. Demonstrate the mass of an object by using a spring balance and an equal arms balance (weight).

05. Construct predictions based on data presented in a bar graph.

06. Describe the kinds of locomotion characteristic of animals having various shapes and appendages.

07. Describe stimulus-response situation in the environment of an animal.

08. Identify and describe bilateral symmetry.

09. Construct a simple classification scheme and demonstrate its use.

10. Describe characteristics such as color, texture, shape, odor, and size of molds and green plants or parts of green plants.

ELEMENTARY SCIENCE
(E-Sci-5)

Key Competencies

GRADE 5

E-Sci-5-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ENERGY SOURCES:

01. Identify and interpret changes occurring in an experiment as evidence of interaction.

02. Identify variables that influence the outcome of a simple experiment.

03. Identify and describe evidence of energy transfer.

04. Identify energy sources and energy receivers.

05. Identify energy chains in the everyday environment.

06. Indicate the temperature of a system by using a thermometer.

07. Identify and distinguish the amount of transferred energy as indicated by changes of temperature.

08. Identify variables that affect the amount of energy transferred to a moving object.

09. Describe energy sources and receivers during observations of ice melting and crystals dissolving.

10. Construct a plan for carrying out a systematic and independent investigation.

11. Construct a graph for displaying data obtained in experiments.

E-Sci-5-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO LIVING COMMUNITIES:

01. Identify the food sources of plants by investigations and experiments.

02. Describe through a demonstration how to trace food throughout the life cycle of a plant.

GRADE 5

E-Sci-5-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO LIVING COMMUNITIES (continued):

03. Describe the decomposition of dead plants and animal bodies as evidence of recycling.

04. Identify a community as interdependent populations in a given area.

05. Identify the plants of a community as producers, the animals as consumers, and the molds, bacteria, and yeasts as decomposers.

06. Describe and demonstrate the cyclic path of food and raw materials on a community chart.

07. Observe and describe food chains using frogs, isopods, and mealworms as they are introduced into a terrarium.

08. Construct a terrarium to study food transfer between plants and animals.

09. Identify, measure, and record food intake of crickets which consume mustard seeds in the terrarium.

10. Construct a food web with man as the center population.

E-Sci-5-3 STUDENTS WILL DEMONSTRATE INVESTIGATIVE SKILLS USED IN SCIENCE:

01. Distinguish and demonstrate how to measure temperature using a thermometer calibrated in Fahrenheit and Celsius.

02. Construct graphs that display and communicate data obtained in investigations.

03. Construct a hypothesis.

04. Construct predictions from recorded data.

05. Identify recorded data which will either support a hypothesis or disprove it.

06. Identify and record all data by using the metric system.

ELEMENTARY SCIENCE
(E-Sci-5)

Key Competencies

GRADE 6

E-Sci-6-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS IN DEVELOPING SCIENTIFIC THEORIES:

01. Identify and demonstrate simple electrical circuits using a 1-1/2 volt dry cell, #20 copper wire and 1-1/2 volt flashlight bulb.

02. Demonstrate a complete circuit and an open circuit.

03. Demonstrate and describe the path that electricity takes in a 1-1/2 volt flashlight bulb.

04. Construct and demonstrate independent investigations of variables in electric interactions.

05. Construct models for explaining simple electrical and mechanical systems.

06. Describe and evaluate models by interpreting evidence, making predictions, and demonstrating hypotheses.

07. Demonstrate and describe that the total amount of energy in a system remains constant.

08. Demonstrate the field of a magnet system by using a compass and iron filings.

09. Describe magnetic fields including that of the earth.

10. Identify permanent and temporary magnets.

11. Describe and evaluate models by interpreting evidence, making predictions, and performing experiments.

12. Demonstrate that magnets will attract or repel other magnets under specified conditions.

GRADE 6

E-Sci-6-1 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS IN DEVELOPING SCIENTIFIC THEORIES (continued):

13. Identify an electricity model for predicting and explaining energy transfer in electric circuits.

14. Identify variables in an electric circuit.

15. Construct and demonstrate independent investigations of variables in electric interactions.

16. Construct graphs for displaying data obtained in investigations and experiments.

E-Sci-6-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ECOSYSTEMS:

01. Identify the environmental factors affecting the life cycle of an organism.

02. Describe and predict responses of organisms to selected variations in environmental conditions.

03. Identify optimum conditions for certain organisms in terms of selected environmental factors.

04. Identify sources of pollution in the ecosystem and describe the effects of these on the structure of a biotic community.

05. Describe an ecosystem in terms of materials cycling through organisms and the environment (e.g., water cycle, oxygen-carbon dioxide cycle, mineral cycle, pollutants).

06. Identify and describe the terms introduced in previous life science units to explain changes that occur in aquarium-terrarium systems.

07. Describe conditions that are necessary for evaporation and condensation of a liquid.

08. Distinguish and compare the experimental water cycle to the water cycle in nature.

GRADE 6

E-Sci-6-2 STUDENTS WILL DEMONSTRATE KNOWLEDGE AND SKILLS RELATED TO ECOSYSTEMS (continued):

09. Demonstrate how data is used to verify hypotheses about gases that plants and animals produce and use.

10. Demonstrate the oxygen-carbon dioxide cycle and describe the exchange of gases between organisms and their environment.

11. Describe ecosystems in terms of materials cycling through organisms and the environment.

12. Describe the term pollutant when referring to a substance that is added to an ecosystem in quantity harmful to organisms.

13. Describe the effects of pollution on the structure of a biotic community.

14. Identify sources of pollution in an ecosystem.

E-Sci-6-3 STUDENTS WILL DEMONSTRATE SKILLS IN EXPERIMENTAL EVIDENCE:

01. Identify and describe objects by their properties, changes in properties, controlled observations, and ordering of a series of observations.

02. Describe and demonstrate how to classify objects, actions, and phenomena.

03. Describe and demonstrate measurement of length, area, volume, weight, temperature, force, and speed.

04. Identify and organize information pertaining to a scientific investigation; describe it verbally or graphically, and present the data in such a way that trends can be analyzed.

05. Describe and demonstrate that a prediction is an outcome from a trend in data by using inference, extrapolation, or interpolation.

GRADE 6

E-Sci-6-3 STUDENTS WILL DEMONSTRATE SKILLS IN EXPERIMENTAL EVIDENCE (continued):

06. Identify the independent and dependent variables of an experiment and describe how variables are controlled and interrelated.

07. Demonstrate how to assemble and use appropriate tools and apparatus needed to investigate a scientific problem.